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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/536,993	05/31/2005	Toshitsugu Sakamoto	8017-1169	9950

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2826	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/536,993	SAKAMOTO ET AL.	
	Examiner	Art Unit	
	Leslie P. Cruz	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 November 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-8,20,21 and 27-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8,20,21 and 27* is/are rejected.

7)☒ Claim(s) *28-29* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *11/09/2007* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date ___.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Acknowledgements

The amendment filed on 09 November 2007 in response to the Office Action mailed on 09 August 2007 has been entered. The present Office Action is made with all the suggested amendments being fully considered. Accordingly, pending in this Office Action are claims 1-8, 20, 21 and 27-29.

Drawings

The drawings filed on 09 August 2007 are acceptable.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 1-8, 20, 21 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Haase (US 2003/0211724 A1) in view of Dubin et al. (US 5,913,147).

With respect to claim 1, Haase (Figs. 1 & 2) discloses a semiconductor device comprising a connection plug [40] defined by a via hole filled with a conductive barrier material [34b] comprising a nanomaterial [32, 48] surrounded by the conductive barrier material, wherein the nanomaterial is substantially uniformly disposed in a section of the via hole, and the conductive barrier material both surrounds the nanomaterial and fills

the via hole [paragraphs 0021-0022]. Haase does not specify the conductive barrier material is a metal. However, Dubin et al. (Fig. 1) teaches it is well known for a metal such as tantalum to be used as a barrier material between a copper wire [16] and a dielectric layer [12]. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the conductive barrier material of Haase to be a metal, such as taught by Dubin et al., in order to improve the adhesion of copper [34a, Fig. 2 of Haase] to dielectric layer [26, Fig. 2 of Haase] [Dubin et al., column 1 lines 31-39].

With respect to claim 3, Haase in view of Dubin et al. discloses the semiconductor according to claim 1. Haase further discloses the nanomaterial is a fibrous carbon nanomaterial or a particle-like carbon nanomaterial [paragraph 0015].

With respect to claim 5, Haase in view of Dubin et al. discloses the semiconductor according to claim 1. Haase (Figs. 1 & 2) further discloses the nanomaterial is oriented substantially perpendicularly to a substrate [16, paragraph 0020].

With respect to claim 7, Haase in view of Dubin et al. discloses the semiconductor according to claim 1. Haase (Fig. 1) further discloses the nanomaterial is provided in the whole connection plug.

With respect to claim 20, Haase in view of Dubin et al. discloses the semiconductor according to claim 1. Haase (Figs. 1 and 2) further discloses the conductive barrier material comprises the nanomaterial. The limitation "metal layer is formed by a plating liquid comprising the nanomaterial" is a product by process

limitation and is not given patentable weight. Therefore, claim 20 is not patentable distinguishable over the Haase in view of Dubin et al. reference. See note below.

With respect to claim 2, Haase (Figs. 1 & 2) discloses a semiconductor device comprising: an insulating film [16]; an interlayer dielectric film [26] on the insulating film; a trench [24] within the dielectric film; an interconnection [40] comprising a conductive barrier material [34b] filling the trench; and nanotubes [32, 48] mixed in the conductive barrier material, wherein the nanotubes are of a nanomaterial substantially uniformly formed on a bottom surface of the interconnection [paragraph 0015, 0021]. Haase does not specify the conductive barrier material is a metal. However, Dubin et al. (Fig. 1) teaches it is well known for a metal such as tantalum to be used as a barrier material between a copper wire [16] and a dielectric layer [12]. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the conductive barrier material of Haase to be a metal, such as taught by Dubin et al., in order to improve the adhesion of copper [34a, Fig. 2 of Haase] to dielectric layer [26, Fig. 2 of Haase] [Dubin et al., column 1 lines 31-39].

With respect to claim 4, Haase in view of Dubin et al. discloses the semiconductor device according to claim 2. Haase further discloses the nanomaterial is a fibrous carbon nanomaterial or a particle-like carbon nanomaterial [paragraph 0015].

With respect to claim 6, Haase in view of Dubin et al. discloses the semiconductor device according to claim 2. Haase (Figs. 1 & 2) further discloses the nanomaterial is oriented substantially perpendicular to a substrate [16, paragraph 0020].

With respect to claim 8, Haase in view of Dubin et al. discloses the semiconductor device according to claim 2. Haase (Figs. 1 & 2) further discloses the nanomaterial is provided up to the vicinity of a top surface of the interconnection.

With respect to claim 21, Haase in view of Dubin et al. discloses the semiconductor according to claim 2. Haase (Figs. 1 &2) further discloses the conductive barrier material comprises the nanomaterial. The limitation "metal layer is formed by a plating method a plating liquid comprising the nanomaterial" is a product by process limitation and is not given patentable weight. Therefore, claim 20 is not patentable distinguishable over the Haase in view of Dubin et al. reference. See note below.

With respect to claim 27, Haase (Figs. 1 &2) discloses a semiconductor device comprising: an insulating film [16]; an interlayer dielectric film [16] on the insulating film; a trench [24] within the dielectric film; an interconnection [40] comprising a conductive barrier material [34b] filling the trench; a tungsten layer [30, paragraph 0022] coating a bottom [30 at bottom] and sides [paragraph 0022] of the trench, the tungsten layer located intermediate the conductive barrier metal layer separating the conductive barrier material from the dielectric film; particles of metal [42] on a lower horizontal surface of the tungsten layer; carbon nanotubes [32, 48] formed on the metal particles and mixed in the conductive barrier material. Haase does not specify the conductive barrier material is a metal or that tungsten is a barrier metal layer. However, Dubin et al. (Fig. 1) teaches it is well known for a metal such as tantalum to be used as a barrier material between a copper wire [16] and a dielectric layer [12]. Dubin et al. is also cited for the

well known position that tungsten may be used as a barrier metal layer [column 1 lines 31-39]. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the conductive barrier material of Haase to be a metal, such as taught by Dubin et al., in order to improve the adhesion of copper [34a, Fig. 2 of Haase] to dielectric layer [26, Fig. 2 of Haase] [Dubin et al., column 1 lines 31-39].

Product by Process

Note that a "product by process" claim is directed to the product per se, no matter how actually made, *In re Hirao, 190 USPQ 15 at 17* (footnote 3). See also *In re Brown, 173 USPQ 685*; *In re Luck, 177 USPQ 523*; *In re Fessmann, 180 USPQ 324*; *In re Avery, 186 USPQ 161*; *In re Wertheim, 191 USPQ 90* (*209 USPQ 554* does not deal with this issue); and *In re Marosi et al., 218 USPQ 289*, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in " product by process" claims or not. Note that applicant has the burden of proof in such cases, as the above case law makes clear. See also MPEP § 706.03(e).

Response to Arguments

Applicant's arguments, see pages 12-14, filed 09 November 2007, with respect to the rejection(s) of claim(s) 1 and 2 under 35 U.S.C. 102(e) and 35 U.S.C. 103(a) have been fully considered and are persuasive. Therefore, the rejection has been

withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Dubin et al. (US 5,913,147).

Allowable Subject Matter

The indicated allowability of claim 27 is withdrawn in view of the newly discovered reference(s) to paragraph 0022 of Haase (US 2003/0211724 A1). Rejections based on the newly cited reference(s) are shown above.

Claims 28-29 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

The prior art of record taken either singly or in combination fails to anticipate or fairly suggest the limitations which the Applicant claims in claim 28 in a manner which would warrant a rejection under 35 U.S.C. § 102 or 35 U.S.C. § 103.

There was no prior art found by the examiner that suggested modification or combination with the cited prior art so as to satisfy the combination of the present dependent claim 28; especially, the prior art does not provide that each of i) the trench, ii) the interconnection, iii) the metal layer, iv) the barrier metal layer, and the carbon nanotubes extend through the first etching stopper layer as recited in claim 28.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in the Office action mailed 09 August 2007. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Telephone/Fax Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Leslie P. Cruz whose telephone number is 571-272-8599. The examiner can normally be reached on Monday-Friday 9:00-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisors, Sue A. Purvis can be reached on 571-272-1236. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Leslie Pilar Cruz
Examiner
Art Unit 2826

lpc

SUE A. PURVIS
SUPERVISORY PATENT EXAMINER